

REMARKS

The present amendment is in response to the Office Action dated July 6, 2009. claims 1, 5, 9-12, 14, 18-29, and 34-41 are present in the case. By this amendment, claims 2-4, 6-8, 13, 15-17, and 30-33 have been canceled without prejudice to their inclusion in a divisional or continuation application. Further, claims 1, 5, 9, 12, 14, 18, 19, 20, 23-29, and 37 have been amended and new claims 38-41 have been added.

Claim Objections

Claim 32 has been objected to because of an informality. This objection has been rendered moot in light of the cancellation of this claim.

Rejection of claims under 35 U.S.C. § 112

Claims 4 and 12-22 stand rejected under 35 U.S.C. § 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, the Office Action asserts the term "dense" is a relative term.

However, one of ordinary skill in the art understands the term "dense" as applied to a fuel cell system to mean a material that is impermeable to gas molecules. For example, as explained by the authors of Burggraaf, A.J., & Cot, L. (Eds.), "Membrane Science and Technology Series 4: Fundamentals of Inorganic Membrane Science and Technology" (Netherlands: Elsevier, 1996) at p. 21, "[d]ense membranes are made from solid layers (e.g. Pd alloys) for hydrogen separation, or of mixed (electronic, ionic) conducting oxides for oxygen separation." Please see attached printout from Google Books. By contrast, "[p]orous membranes consist of porous wall or porous top layers (metal oxide, glass) on a porous (meta-oxide) support" (*Ibid*). Thus, claims 12-22 particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Rejection of Claims 1-3 and 30 and 33 under 35 U.S.C. §§ 102(b) and 103(a)

Claims 1-3 and 30 and 33 stand rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, as obvious under 35 U.S.C. 103(a) in view of U.S. Patent No. 6,492,050 issued to Sammes. Claims 2, 3, 30, and 33 have been canceled.

Independent claim 1 has been amended to recite "the heater comprising a sufficiently porous outer tube to enable the fuel and air reactants to pass through the outer tube." At page 6 (addressing claims 5, 14, 18-20, 22-23 and 25), the Office Action acknowledges that Sammes and U.S. Patent Publication No. 2005/0066663 filed by Alvin are silent with respect to a combustion heater having a porous wall.

For this claim element, the Office Action cites CN 85100996 ("Shen"). Shen discloses an organic polymer powder with high decomposition temperature used as pore-forming reagent, which is mixed with metal powder in appropriate proportion and sprayed with oxy-acetylen flame on the treated surface of metal tube, forming a porous layer. The porous layer is used in tubular heat exchangers needed by chemical, petroleum, metallurgical and power industries for intensifying boiling-heat transfer, so as to increase heat transfer coefficient, to reduce effective temperature difference, to reduce heat transfer area and to lower both expenses of metal and energy consumption. Shen does not teach or suggest a wall or tube through which fuel and/or oxidant reactants may pass. Shen specifically states that the porous layer is formed on a metal tube. Any reactants contained within the metal tube would not be permitted to pass through the metal tube due to its inherent non-porous nature.

In sum, Sammes, Alvin, and Shen alone and in hypothetical combination fail to teach or suggest a system comprising a combustion heater comprising a porous wall or a tube that enable fuel and/or oxidant reactants to pass therethrough. Therefore, withdrawal of this ground for rejection is respectfully requested.

Rejection of Claims 12, 13, and 15 under 35 U.S.C. § 103(a)

Claims 12-13 and 15 stand rejected under 35 U.S.C. § 103(a) as rendered obvious by Sammes in view of U.S. Patent Application Publication No. 2005/0066663 filed by Alvin. Claims 13 and 15 have been canceled.

Independent claim 12 has been amended to claim "a combustion heater comprising a first tube, a dense second tube within the first tube and a porous third tube inside the second tube" and "the third tube sufficiently porous to enable the fuel and air reactants to pass through the third tube." For at least the reasons discussed above with respect to claim 1, none of the cited prior art references alone or in hypothetical combination teach or suggest these elements of claim 12. Therefore, withdrawal of this ground for rejection is respectfully requested.

Rejection of Claims 12, 13, and 15 under 35 U.S.C. § 103(a)

Claims 4, 9, and 10 stand rejected under 35 U.S.C. § 103(a) as rendered obvious by Sammes as applied to claims 1-3, 30 and 33 above, and in view of Alvin. Claim 4 has been canceled. Claim 9 has been amended into independent form. Claim 10 depends from claim 9.

Claims 9 and 10 recite a solid oxide fuel cell system that comprises, *inter alia*, a tubular thermal casing and combustion heater containing at least one tubular solid oxide fuel cell, the casing and heater "arranged to define an annular chamber therebetween that is fluidly communicable with an air and fuel mixture, and one or both of the heater and casing are coated with catalytic material effective to combust the air and fuel mixture" in the annular chamber. Thus, the at least one solid oxide fuel cell is heated by combustion of a fuel and air mixture in the annular chamber surrounding the fuel cell. The structure of the system provides for a compact fuel cell system and a heater comprising a large outer heating surface resulting in a high heat transfer to the at least one fuel cell contained in the heater.

In contrast, Sammes discloses a tubular heater (combustion chamber 41) and a casing (outer shell 58) that form an annular chamber 46 therebetween, however, the annular chamber 46 is in fluid communication solely with a fuel reactant 71 and combustion occurs in the combustion chamber 41, not in the annular chamber 46. By further contrast, Alvin discloses a tubular heater (catalyst-coated channels 144) that is fluidly communicable with a fuel and air mixture, however, Alvin does not disclose an annular chamber formed between a casing and the heater, nor a fuel cell contained in a heater.

In sum, Sammes and Alvin alone and in hypothetical combination fail to teach or suggest a system comprising a casing and tubular heater, an annular space defined in-between the casing and the tubular heater, the annular space being a combustion chamber, and at least one fuel cell contained in the heater. Therefore, withdrawal of this ground for rejection is respectfully requested.

Rejection of Claims 5, 14, 18-20, 22-23, and 25 under 35 U.S.C. § 103(a)

Claims 5, 14, 18-20, 22-23, and 25 stand rejected under 35 U.S.C. § 103(a) as rendered obvious by Sammes or Sammes in view of Alvin as applied to claim 1-4, 9-10, 30 and 33 above, and further in view of Chinese Patent No. CN85100996 issued to Shen.

Claims 5, 14, 23, and 25 depend from claim 1 and are allowable over Sammes and Alvin alone and in hypothetical combination for at least the same reasons (discussed above) that claim 1 is allowable over these references. As explained above, Chen does not cure the deficiencies of Sammes and Alvin.

Claims 18 and 19 depend from claim 12 and are allowable over Sammes and Alvin alone and in hypothetical combination for at least the same reasons (discussed above) that claim 12 is allowable over these references. As explained above, Chen does not cure the deficiencies of Sammes and Alvin.

Independent Claim 20 recites "a combustion heater comprising a first tube, a dense second tube within the first tube and a porous third tube inside the second tube" and "the second combustion chamber fluidly communicable with the fuel and oxidant, the fuel and oxidant forming a mixture therein that permeates radially through the third tube and into the first combustion chamber for combusting." For the reasons, described above with respect to claim 1, none of the cited prior art teach or suggest a solid oxide fuel cell system comprising a combustion heater comprising a sufficiently porous third tube to enable the fuel and air reactants to pass through the third tube.

Claim 22 depends from claim 20 and is allowable over Sammes, Alvin, and Chen alone and in hypothetical combination for at least the same reasons (discussed above) that claim 20 is allowable over these references.

Therefore, withdrawal of this ground for rejection is respectfully requested.

Rejection of Claims 31 and 32 under 35 U.S.C. § 103(a)

Claims 31 and 32 stand rejected under 35 U.S.C. § 103(a) as rendered obvious by Sammes as applied to claims 1-4, 9-10, 30 and 33 above, and further in view of U.S. Patent No. 5,932,181 issued to Kim. Claims 31 and 32 have been canceled rendering this rejection moot.

Rejection of Claim 7 under 35 U.S.C. § 103(a)

Claim 7 stands rejected under 35 U.S.C. § 103(a) rendered obvious by Sammes in view of Alvin as applied to claims 1-4, 9-10, 30 and 33 and further in view of U.S. Patent Application Publication No. 2004/0105789 filed by Yamamoto. Claim 7 has been canceled rendering this rejection moot.

Rejection of Claims 6, 8, 11, 16, 17, and 27-29 under 35 U.S.C. § 103(a)

Claims 6, 8, 11, 16, 17, and 27-29 stand rejected under 35 U.S.C. § 103(a) as rendered obvious by Sammes or Sammes in view of Alvin as applied to claims 1-4, 9-10 and 30-33 and further in view of U.S. Patent Application Publication No. 2003/0235732 filed by Haltiner. Claims 6, 8, 11, 16, and 17 have been canceled rendering this rejection moot with respect to those claims.

Claims 11 and 27-29 depend from claim 9 and are allowable over Sammes and Alvin alone and in hypothetical combination for at least the same reasons (discussed above) that claim 9 is allowable over these references. Therefore, withdrawal of this ground for rejection is respectfully requested.

Rejection of Claims 21, 24, 26, and 35-37 under 35 U.S.C. § 103(a)

Claims 21, 24, 26, and 35-37 stand rejected under 35 U.S.C. § 103(a) as rendered obvious by Sammes or Sammes in view of Alvin and Shen as applied to claims 1-5, 9-10, 23, 25, 30 and 33 and further in view of Haltiner.

Claims 21 and 36 depend from claim 20 and are allowable over Sammes, Alvin, and Shen alone and in hypothetical combination for at least the same reasons (discussed above) that claim 20 is allowable over these references.

Claims 24, 26, and 37 depend from claim 1 and are allowable Sammes, Alvin, and Shen alone and in hypothetical combination for at least the same reasons (discussed above) that claim 1 is allowable over these references.

Claims 34 and 35 depend from claim 9 and are allowable over Sammes and Alvin alone and in hypothetical combination for at least the same reasons (discussed above) that claim 9 is allowable over these references. As explained above, Chen does not cure the deficiencies of Sammes and Alvin.

Therefore, withdrawal of this ground for rejection is respectfully requested.

Rejection of Claim 34 under 35 U.S.C. § 103(a)

Claim 34 stands rejected under 35 U.S.C. § 103(a) as rendered obvious by Sammes in view of Shen as applied to claims 1-5, 9-10, 23, 25, 30 and 33 and further in view of U.S. Patent Application Publication No. 2004/0105789 filed by Yamamoto.

Claim 34 depends from claim 1 and is allowable over Sammes and Shen alone and in hypothetical combination for at least the same reasons (discussed above) that claim 1 is allowable over these references. Therefore, withdrawal of this ground for rejection is respectfully requested.

New claims

Claims 38-41 depend from claim 1 and are allowable over the cited references alone and in hypothetical combination for at least the same reasons (discussed above) that claim 1 is allowable over these references.

Commissioner is hereby authorized to charge the required fees for the two-month extension of time to Deposit Account No. 04-0258 of Davis Wright Tremaine LLP. If additional fees are believed necessary, the Commissioner is further authorized to charge any deficiency or credit any overpayment to Deposit Account No. 04-0258.

All of the claims remaining in the application are now believed to be allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

If questions remain regarding this application, the Examiner is invited to contact the undersigned at (206) 206-757-8021.

Respectfully submitted,
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2 - IMPORTANT CHARACTERISTICS OF INORGANIC MEMBRANES

Usually a number of membranes are combined in a module, which is the smallest practical unit containing a set of membranes and any supporting structures. Two main classes of membrane can be distinguished: dense (non-porous) and porous ones.

Dense membranes are made from solid layers of metals (e.g. Pd alloys) for hydrogen separation, or of mixed (electronic, ionic) conducting oxides for oxygen separation. A special form are the LIMs (liquid immobilised membranes) which consist of a porous support filled with a liquid or molten salt which is semipermeable.

Porous membranes consist of a porous wall or porous top layers (metal, oxide, glass) on a porous (metal-oxide) support. A variety of pore shapes and architectures exist, as shown in Table 2.1.

The most simple form is a single, uniformly structured wall of a certain material, the so-called symmetric, stand-alone membranes. Examples are dense metal or oxide tubes and porous hollow fibres. To obtain sufficient mechanical strength single-walled symmetric systems usually have a considerable thickness.

TABLE 2.1

Types of inorganic membranes

Type (class)	Material/process	Architecture
LEPAT ...	CDTracker	Internet
VAN_LA...	SmartM...	Exercise...
Funda...		

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